# PRODUCT SERVICE MANUAL
# For
# 3E-187/200 SERIES PUMPS

**WARNING**

The Imo General Installation Operation, Maintenance, and Troubleshooting Manual, (No. SRM00046), along with this manual and all other component manuals supplied with these type units should be read thoroughly prior to pump installation, start-up, operation, maintenance or troubleshooting.


| MANUAL NO. SRM00019 | Rev. 05 (14-0129) | MARCH, 2014 |
|---|---|---|

# READ THIS ENTIRE PAGE BEFORE PROCEEDING

FOR SAFETY OF PERSONNEL AND TO PREVENT DAMAGE TO THE EQUIPMENT, THE FOLLOWING NOMENCLATURE HAS BEEN USED IN THIS MANUAL:

**DANGER**

Failure to observe precautions noted in this box can result in severe bodily injury or loss of life.

**WARNING**

Failure to observe precautions noted in this box can cause injury to personnel by accidental contact with equipment or liquids. Protection should be provided by user to prevent accidental contact.

**CAUTION** **ATTENTION**

Failure to observe precautions noted in this box can cause damage or failure of equipment.

| | | |
|---|---|---|
| Noncompliance of safety instructions identified by the following symbol could affect safety for persons: | Safety instructions where electrical safety is involved are identified by: | Safety instructions which shall be considered for reasons of safe operation of the pump and/or protection of the pump itself are marked by the sign: **ATTENTION** |

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***ATTENTION***

***If operation of this pump is critical to your business, we strongly recommend you keep a spare pump or major repair kit in stock at all times. As a minimum, a minor repair kit (o-rings, gaskets, shaft seal and bearings) should be kept in stock so pump refurbishment after internal inspection can be accomplished.***

## A. GENERAL INSTRUCTIONS

Instructions found herein cover disassembly, assembly and parts identification of 3E-187 & 200 Series, Imo pumps.

**NOTE:** Individual contracts may have specific provision that vary from this manual. Should questions arise which may not be answered by these instructions, refer to the Imo General Installation Operation, Maintenance, and Troubleshooting Manual, (No. SRM00046). For further detailed information and technical assistance please refer to Imo Pump, Technical Service Department at (704) 289-6511.

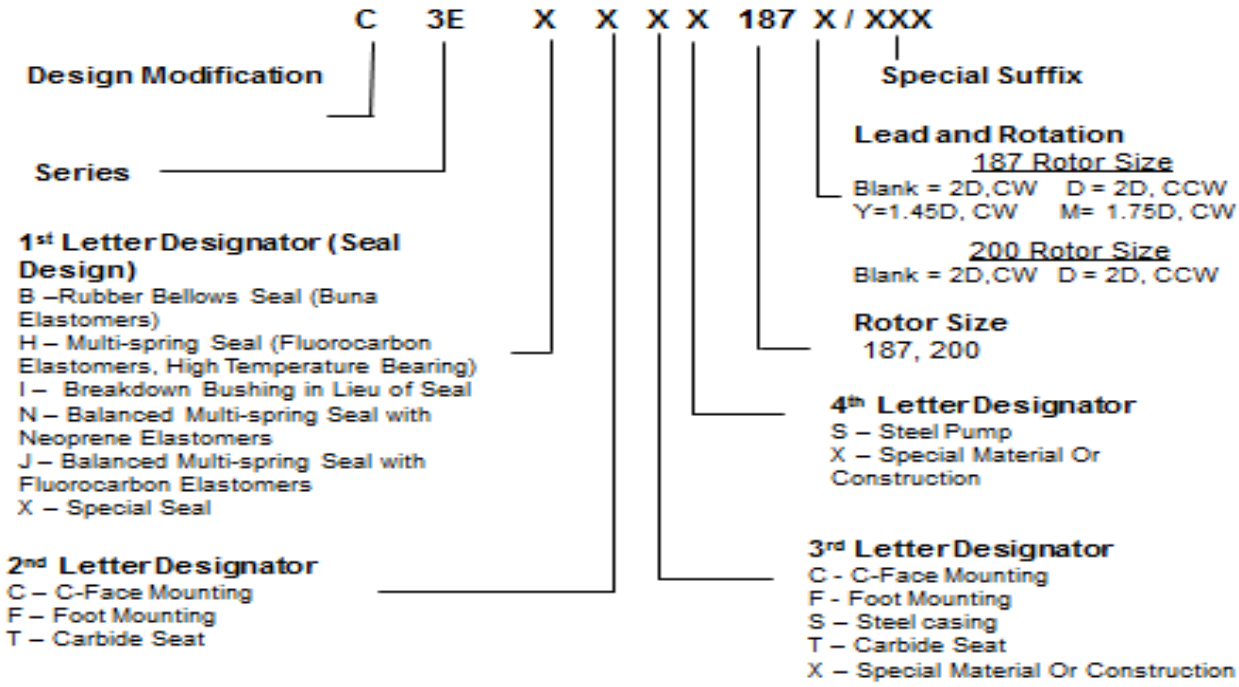
This manual cannot possibly cover every situation connected with installation, operation, inspection and maintenance of equipment supplied. Every effort was made to prepare text of manual so that engineering and design data is transformed into the most easily understood wording. Imo Pump must assume the personnel assigned to operate and maintain supplied equipment and apply this instruction manual have sufficient technical knowledge and are experienced to apply sound safety and operational practices which may not be otherwise covered by this manual.

**WARNING**

If installation, operation and maintenance instructions are not correctly and strictly followed and observed, injury to personnel or serious damage to pump could result. Imo Pump cannot accept responsibility for unsatisfactory performance or damage resulting from failure to comply with instructions.

## B. INTRODUCTION

Instruction manual covers series 3E-187 & 200 Imo Pumps. Series of pumps has been designed for general use in lubricating, seal and distillate fuel oil applications. The size and construction of each pump is identified in model number on the pump nameplate. Definitions of model designators are identified in Figure 1.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Design Modification
Series
1st Letter Designator (Seal Design)
B –Rubber Bellows Seal (Buna Elastomers)
H – Multi-spring Seal (Fluorocarbon Elastomers, High Temperature Bearing)
I – Breakdown Bushing in Lieu of Seal
N – Balanced Multi-spring Seal with Neoprene Elastomers
J – Balanced Multi-spring Seal with Fluorocarbon Elastomers
X – Special Seal
2nd Letter Designator
C – C-Face Mounting
F – Foot Mounting
T – Carbide Seat
Special Suffix
Lead and Rotation
187 Rotor Size
Blank = 2D,CW D = 2D, CCW
Y=1.45D, CW M= 1.75D, CW
200 Rotor Size
Blank = 2D,CW D = 2D, CCW
Rotor Size
187, 200
4th Letter Designator
S – Steel Pump
X – Special Material Or Construction
3rd Letter Designator
C - C-Face Mounting
F - Foot Mounting
S – Steel casing
T – Carbide Seat
X – Special Material Or Construction

**Model Designator Definitions**

## C. DESCRIPTION OF EQUIPMENT

3E-187/200 Series pumps are positive displacement, rotary screw pumps with a precision bored housing that encloses a drive screw (power rotor) and two intermeshing driven screws (idler rotors). These screws, when rotating, form a succession of closures or cavities. As they rotate, fluid is moved axially from inlet to outlet in a continuous, uniform flow with minimum fluid pulsation and pump noise.

## D. ORDERING INSTRUCTIONS

All correspondence pertaining to renewal parts for equipment must refer to instruction manual number and should be addressed to nearest Imo representative. Handling of renewal orders will be greatly facilitated if following directions are carefully observed:

1. Give number of instruction manual with revision level and date.
2. Give model number of pump for which part is desired. Number appears on nameplate.
3. Repair parts are sold in either a major or minor kit form for the pump. Parts are designated by IDP numbers and names and are shown on assembly drawings and as listed in Table 2 in this instruction manual.

## E. OPERATION

**E-1 – LIQUID LIMITATIONS** – Never operate with water. Pump is designed for liquids having general characteristics of oil.

### E-2 – OPERATING LIMITS

| CAUTION | ATTENTION |
|---|---|
| Operating conditions, such as speed, fluid viscosity, temperature inlet pressure, discharge pressure, filtration, duty cycle, drive type, mounting, etc., are interrelated. Due to these variable conditions, specific application limits may be different from that of operational limitations. Equipment must not be operated without verifying system's operating requirements are within pump's capabilities. | |

**Table 1 – Pump Operating and Structural Limits**

**Maximum Speed:**
Type B & H Seals = 4000 RPM for 187 size, 3800 RPM for 200 size.
Type N and J Seals = 3500 RPM
Type I = 4250 RPM for 187 size and 4000 RPM for 200 size
**Viscosity:**
Type B & I = 33 to 3000 SSU (2.1 to 650 CST)
Type H = 33 to 15000 SSU (2.1 to 5000 CST)
Type N and J = 60-5000 SSU (10 to 1080 CST)
**Temperature Range:**
Type B = 0 to 180°F (-18 to 82°C)
Type H, I and N = 0-250°F (-18 to 121°C)
**Maximum Inlet Pressure**:
Type B, H and I = 75 psig max.
Type N and J = 250 Psig max,
**Maximum Discharge Pressure:**
Type B, H and I = 150 psig max.
Type N = 350 Psig Max. (Provided differential pressure does not exceed 150 psid)
**Drive**.....Direct Only
**Filtration**.....See General Installation Manual, SRM00046
**Mounting**.....Foot or Flange Mounted in Any Attitude
**Shaft Rotation** ..... Available in CW or CCW versions (Pump is not bi-rotational).

## F. PARTS LIST TABLE – TABLE 2

| IDP | QTY | DESCRIPTION |
|---|---|---|
| 1XX | 1 | Housing |
| 2 | 1 | Inlet Head |
| 3 | 4 | Main Hex Capscrews |
| 4 | 1 | Inboard Cover |
| 6 | 4 | Retainer Capscrews |
| 7XX | 1 | Power Rotor |
| 8XX | 2 | Idler Rotor |
| 11X | 1 | Ball Bearing |
| 12 | 1 | Bearing Retainer |
| 13 | 1 | Key |

| IDP | QTY | DESCRIPTION |
|---|---|---|
| 15X | 2 | Retaining Ring |
| 16X | 1 | Seal |
| 26X | 1 | O-ring |
| 32XX | 1 | Thrust Plate |
| 33 | 2 | Thrust Spacer |
| 34 | 2 | Thrust Hex Capscrews |
| 35 | 2 | Lock Washer |
| 93 | 1 | Seal Seat Adapter |
| 96X | 1 | Seal Seat Adapter O-Ring |
| | | |

X = Minor Repair Kit Item

XX = Major Repair Kit Item

## G. INSPECTION

Interval for inspection and replacement of worn parts varies with properties of pumped liquid and can only be determined by experience. All internal parts of 3E Series pumps are lubricated by pumped fluids. Pumping liquid which contains abrasive materials or liquid that is corrosive will significantly reduce service life and call for shorter service intervals. A worn pump will be noticeable by excessive vibration, noise, reduction in flow output and/or reduction in system pressure.

## H. PUMP MAINTENANCE

**WARNING**

**Failure to observe precautions while installing, inspecting, and maintaining the pump can cause injury to personnel from accidental handling, e.g.: Liquids that may harm skin or clothing, fire hazard risks from flammable liquids, or injury from high pressure fluid jets.**

**DANGER**

**BEFORE working on equipment, be sure all power to equipment is disconnected and locked-out.**

### H-1 – GENERAL COMMENTS

Part number identifiers (IDPs) contained in Table 2 and shown within parenthesis such as (8) refer to circled numbers shown on the assembly drawings, Figures 3 through 5.

### H-2 – TOOLS REQUIRED

Procedures described in this manual require common mechanics hand tools, an arbor press, a torque wrench and a suitable lifting device such as a sling for smaller pumps or a strap for larger models.

### H-3 – PUMP DISASSEMBLY –

**CAUTION** **ATTENTION**

**Fluid leakage from disassembly of pump may make floor slippery and cause personal injury.**

**The following steps are required before starting any maintenance action:**

a) De-energize and lock out power to driver and tag power control box "**WARNING - Out of Service**".
b) Close all inlet and outlet valves and tag valves "**WARNING - Out of Service**".
c) Vent pressure from pump and drain pumping liquid.
d) Remove pipe fittings/flanges at pump inlet and outlet openings.
e) Remove bolts holding pump to its mounting.
f) Remove coupling and key (13) from power rotor (7) shaft and locate pump on suitable workbench.

**NOTE:** The 3E Series pumps incorporate highly finished precision parts that must be handled carefully to avoid damage to critical machined surfaces. Parts removed should be tagged for identification and their exact positions in the pump carefully noted so that new parts, or removed parts can be properly replaced.

1. If pump is seal-less version (3EIC(S), use assembly drawing figure 3 and skip to step 4 for disassembly, if not proceed below using assembly figures 4 or 5 whichever is applicable.

2. Remove hex capscrews (6) and bearing retainer (12) from inboard cover (4) and then remove power rotor (7) assembly from inboard cover (4). Power rotor (7) assembly includes seal (16), seal seat adapter (93) with its O-ring (96), bearing (11) and snap rings (15).

3. Disassembly power rotor as follows using appropriate assembly and seal drawings, figures 1 and 2:

   a. Remove retaining ring (15) nearest power rotor keyway.

   b. Using a bearing puller remove the bearing (11) from power rotor (7). During the removal of the bearing support the power rotor to prevent the assembly from falling when the bearing comes off the bearing fit of the power rotor (7).

      An optional method for removing the bearing is via the use of an arbor press. To do so involves sliding two small pieces of key stock through the slots between the bearing (11) and bearing spacer/seal seat adapter assembly (93). Place the power rotor (7) in the arbor press with the two pieces of key stock being used to support the assembly and assume the pressure while pressing the power rotor (7) through the bearing (11). When pressing the power rotor through the bearing take care that the key stock does not contact the inner retaining rings (15) there by damaging the retaining rings and retaining grooves on the power rotor(7). During the removal of the bearing support the power rotor (7) to prevent the assembly from falling when the bearing (11) comes off the bearing fit of the power rotor (7).

   c. Remove inner retaining ring (15).

| **CAUTION** | **ATTENTION** |
|---|---|
| Do not drop power rotor (7) as it is pressed from bearing (11) | |

   d. Slide spacer/seal seat adapter sub assembly (93) with O-ring (96) and seal (016) stationary seat from power rotor (7). Remove seal (16) stationary seat and O-ring from spacer/seal seat adapter sub assembly (93). Remove seal (16) rotating seat from power rotor (7).

**NOTE:** If seal (16) is multi-spring or balanced multi-spring type, loosen the set screws that secure the rotating portion of the seal to the power rotor (7). Using a twisting motion remove the rotating half of the seal from the power rotor (7). If the seal is the rubber bellows type remove the rotating portion of the seal using a twisting motion as this portion of the seal may be stuck to the power rotor (7).

e. If seal only is to be replaced, disassembly is complete. Proceed to step 6 in H4 for reassembly of power rotor and pump. Otherwise proceed to step 4 below.

4. Remove inlet (2) and housing (1) with pin from inboard cover (4) by removing hex capscrews (3). Remove O-ring (26) from inboard cover (4).

5. Remove thrust plate (32) and spacers (33) from housing (1) by removing hex capscrews (34) and washers (35).

6. Remove idlers (8) from housing (1). (For 3EIC(S) version also remove power rotor (7) from housing (1)).

## H4. PUMP REASSEMBLY

General: Prior to reassembly, inspect, clean and coat all internal parts with fluid being pumped. Rotate power rotor (7) frequently during assembly to ensure freedom of rotation. It is recommended that all O-rings (96, 26), seal (16) and bearing (11) be replaced whenever they are removed from their installed position.

1. Assemble washers (35), thrust plate (32) and spacers (33) onto hex capscrews (34). Install hex capscrews (34) into housing (1). Torque capscrews (34) to value on assembly drawing.

2. Install idlers (8) into housing (1) from discharge end of pump. Ensure that end of idlers (8) with root diameter taper goes toward inlet (thrust) end of housing (1).

3. If pump is 3EIC version, install power rotor (7) into housing

4. Install O-ring (26) into groove in front cover (4) and housing (1) assembly with installed idlers (8) (and power rotor if 3EIC) and thrust plate (32) into front cover (4) using hex capscrews (3). Be sure pin in housing (1) engages pin hole in inboard cover (4).

| **CAUTION** | **ATTENTION** |
|---|---|
| Be sure idlers (8) (and power rotor (7) if 3EIC pump) do not drop out of housing (1) when installing housing (1) on inboard cover (4). | |

5. If reassembling 3EIC pump, assembly is complete. Otherwise proceed below.

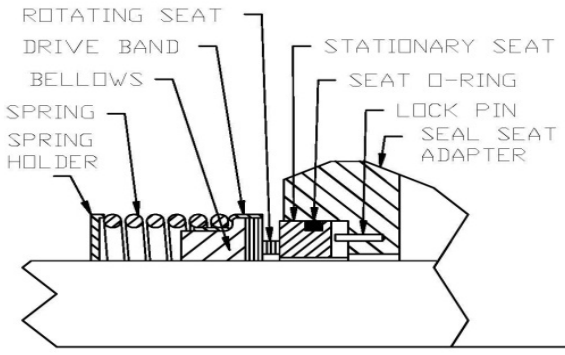
| **CAUTION** | **ATTENTION** |
|---|---|
| The below steps are critical in preventing damage to the mechanical seals during assembly. If the below steps are not carefully followed mechanical seal leakage may occur! | |

6. Assemble power rotor (7) as below:

   a. If seal is elastomeric bellows type, (Fig. 1), apply light film of oil to bellows bore on the rotating portion of mechanical seal. Apply a light film of oil on the seal fit area of the power rotor. Caution must be taken when sliding rotating assembly over snap ring grooves. Check the snap ring grooves to ensure no burrs are present that might cause damage to the rotating assembly of the seal. Install rotating assembly on power rotor (7) using a twisting motion. Clean carbon face of the rotating portion of the seal with alcohol and a lint free cloth. Apply light film of clean lubricating oil to carbon face.

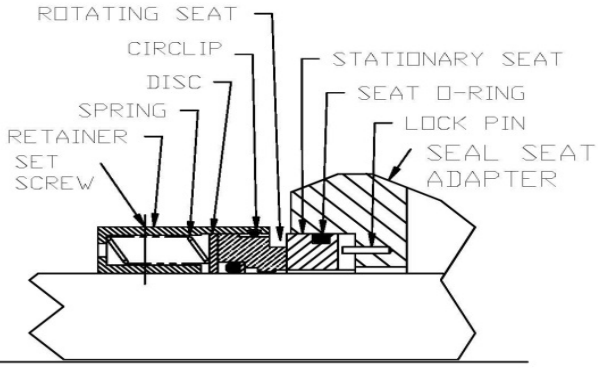
   b. If seal is multi-spring type, (Fig. 2), apply light film of oil to rotating seat O-ring and on the seal fit area of the power rotor (7). Caution must be taken when sliding rotating assembly over snap ring grooves. Check the snap ring grooves to ensure no burrs are present that might cause damage to the O-ring. Install rotating assembly on power rotor (7) shaft using a twisting motion. Clean carbon face of the rotating portion of the seal with alcohol and a lint free cloth. Apply light film of clean lubricating oil to carbon face.

   c. Install O-ring on stationary seal face (Fig 1 and 2). Install stationary seal face into bore of seal seat adapter assembly (93) by pressing it into position with fingers (do not touch seal face with any tools). When installing the stationary seal face into seal seat adapter assembly (93), ensure that the slot on the back of the stationary seal face assembly is perfectly aligned with the anti-rotation pin located in the face of the seal seat adapter assembly (93). After assembly is complete ensure that the stationary seal face assembly bottoms out at the face of the seal seat adapter assembly (93) and the anti-rotation pin slot is mated with the anti-rotation pin in the seal seat adapter assembly (93).




SINGLE SPRING RUBBER BELLOWS SEAL

FIGURE 1




MULTI-SPRING SEAL

FIGURE 2

d. Clean the stationary seal face with alcohol and a lint free cloth. Apply a light coat of oil to the seal face. Install seal seat adapter assembly (93) with installed stationary seat onto power rotor with face of stationary seal up against face of rotating seat seal face.

e. Install snap rings (15) in inner snap ring grooves of power rotor (7) next o seal seat adapter assembly (93).

f. Support power rotor (7) on suction end and press ball bearing (11) on power rotor (7), pressing on inner race of bearing (11) only until it seats against inner snap ring (15). Install outer snap ring (15) nearest shaft (7) keyway. If mechanical seal is a Multi-Spring Type Seal, (Fig 2 Only) tighten set screws in rotating half of the mechanical seal.

7. Install O-ring (96) on seal seat adapter assembly (93). Install assembled power rotor (7) into inboard cover (4). Power rotor should be turned while installing to mesh with idlers (8).

8. Install bearing cover (12) with hex capscrews (6), and torque to value on assembly drawing.

## I. TROUBLESHOOTING

For assistance with troubleshooting see General Instruction Manual, SRM00046.

## J. FIELD AND FACTORY SERVICE AND PARTS

Imo Pump maintains a staff of trained service personnel that can provide pump installation, pump start-up, maintenance/overhaul and troubleshooting supervision as well as installation and maintenance training.

Our factories provide maintenance as well as overhaul and test facilities in event user prefers to return pumps for inspection or overhaul. Pumps that have been factory-overhauled are normally tested and warranted “as-new” for a period of one year from date of shipment. For either field service or factory overhaul assistance, contact your local Imo Sales Office or representative at Technical/Customer Service Department in Monroe, NC, USA.

Most pumps have repair kits available. Minor Repair Kits are used to repair leaking seals, bad bearings and/or for re-assembly after pump tear-down. They include (as applicable) pump shaft seals, all gaskets/O-rings and bearings. Major Repair Kits are sufficient to rebuild completely worn-out pumps to “as-new” condition. They include all parts found in Minor Repair Kits plus all major internal parts subject to wear. Since kits have all necessary parts, it is preferred that they be purchased rather than selecting individual parts. When parts are individually selected from Parts List, some needed components are often overlooked. In addition, mixing worn or used parts with new parts risks rapid wear and shortened service life from new parts.

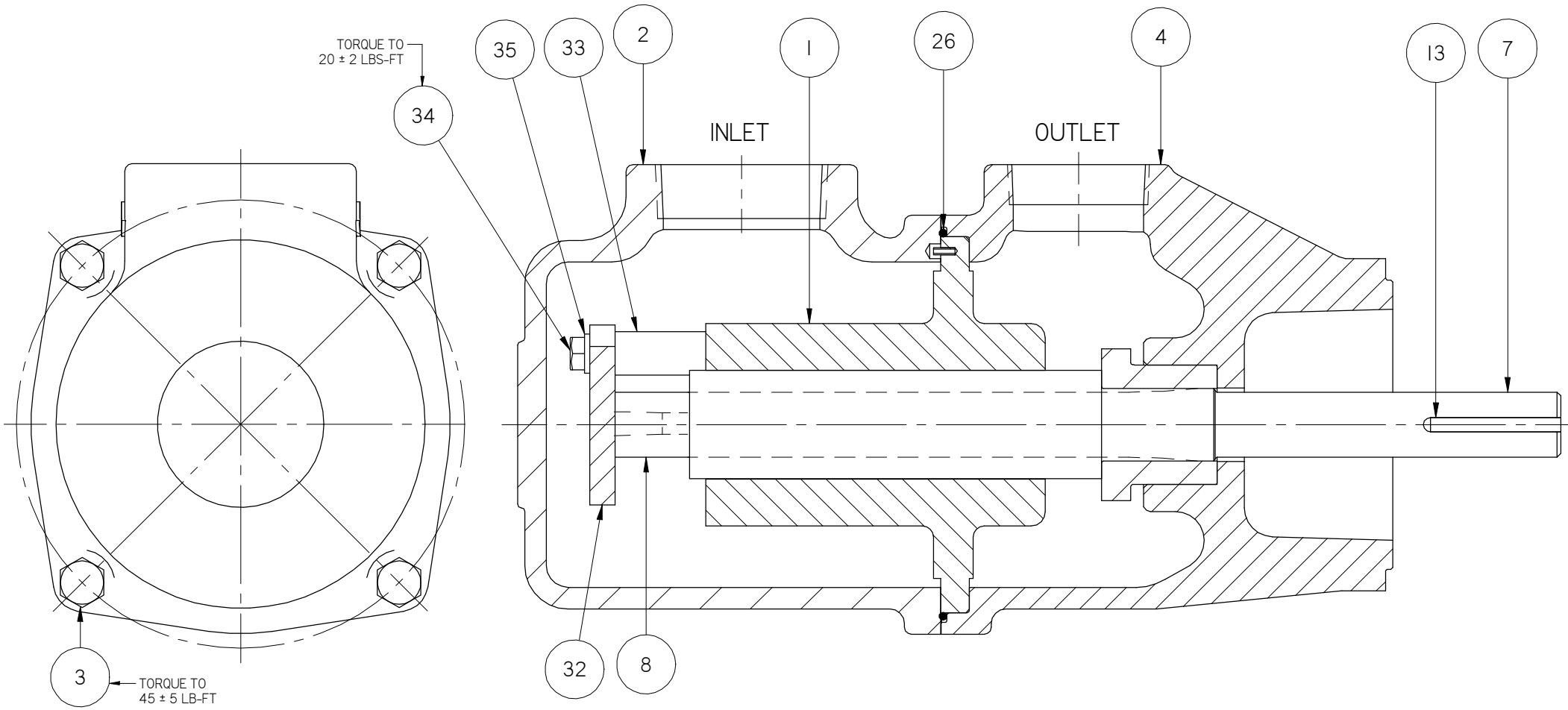



FIGURE 3 - ASSEMBLY FOR SEAL-LESS (3EIC) PUMPS

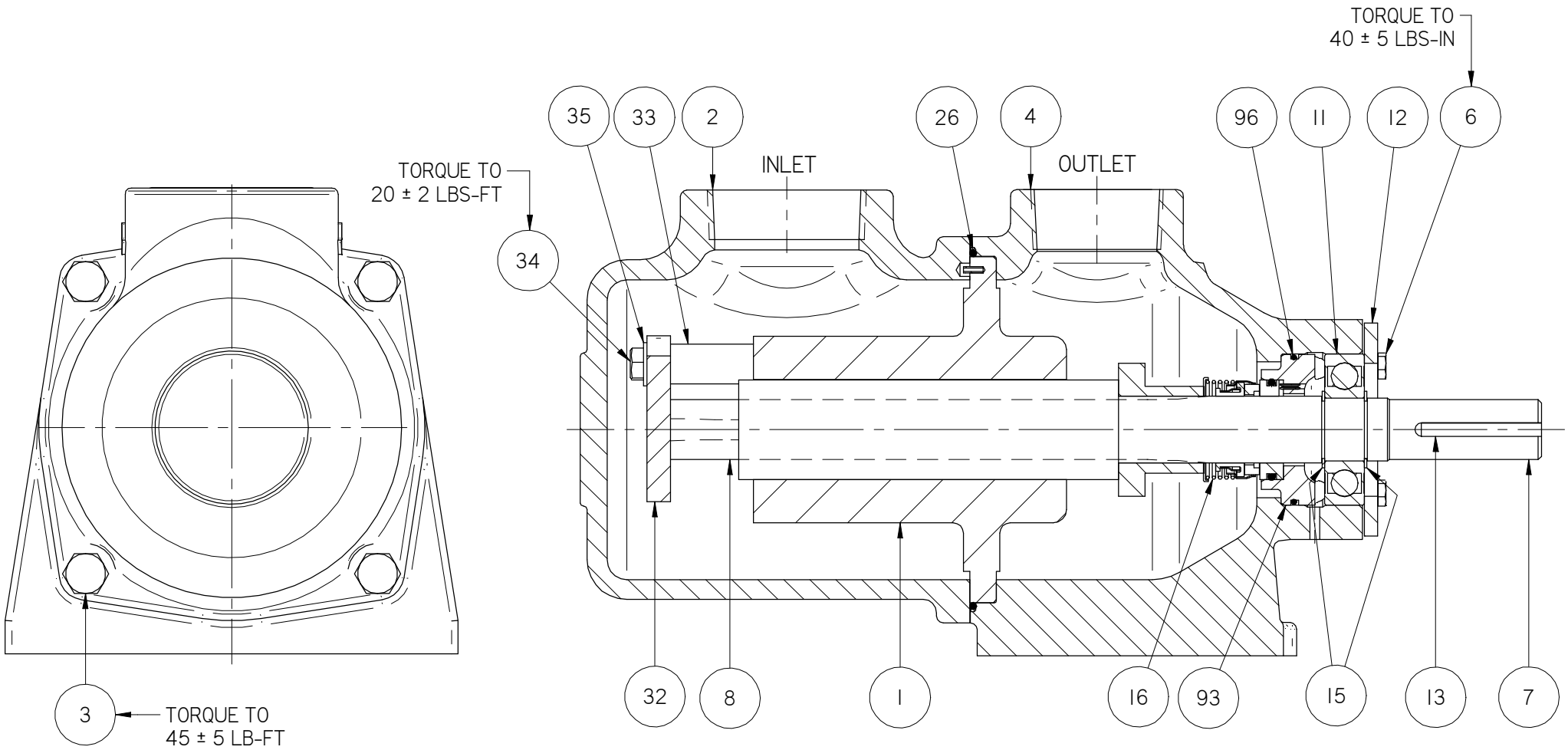



FIGURE 4 - ASSEMBLY FOR FOOT MOUNT & C-FACE (3EB,3EH) PUMPS

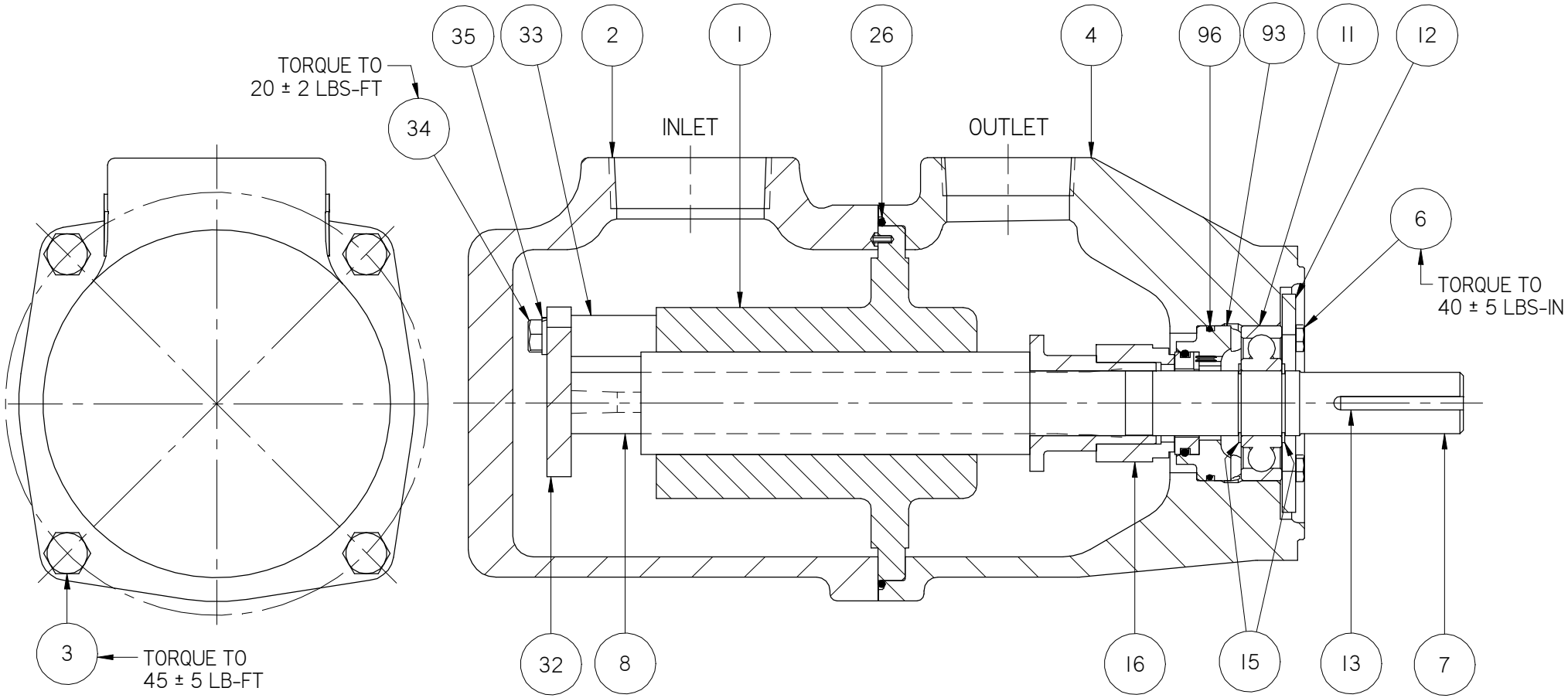
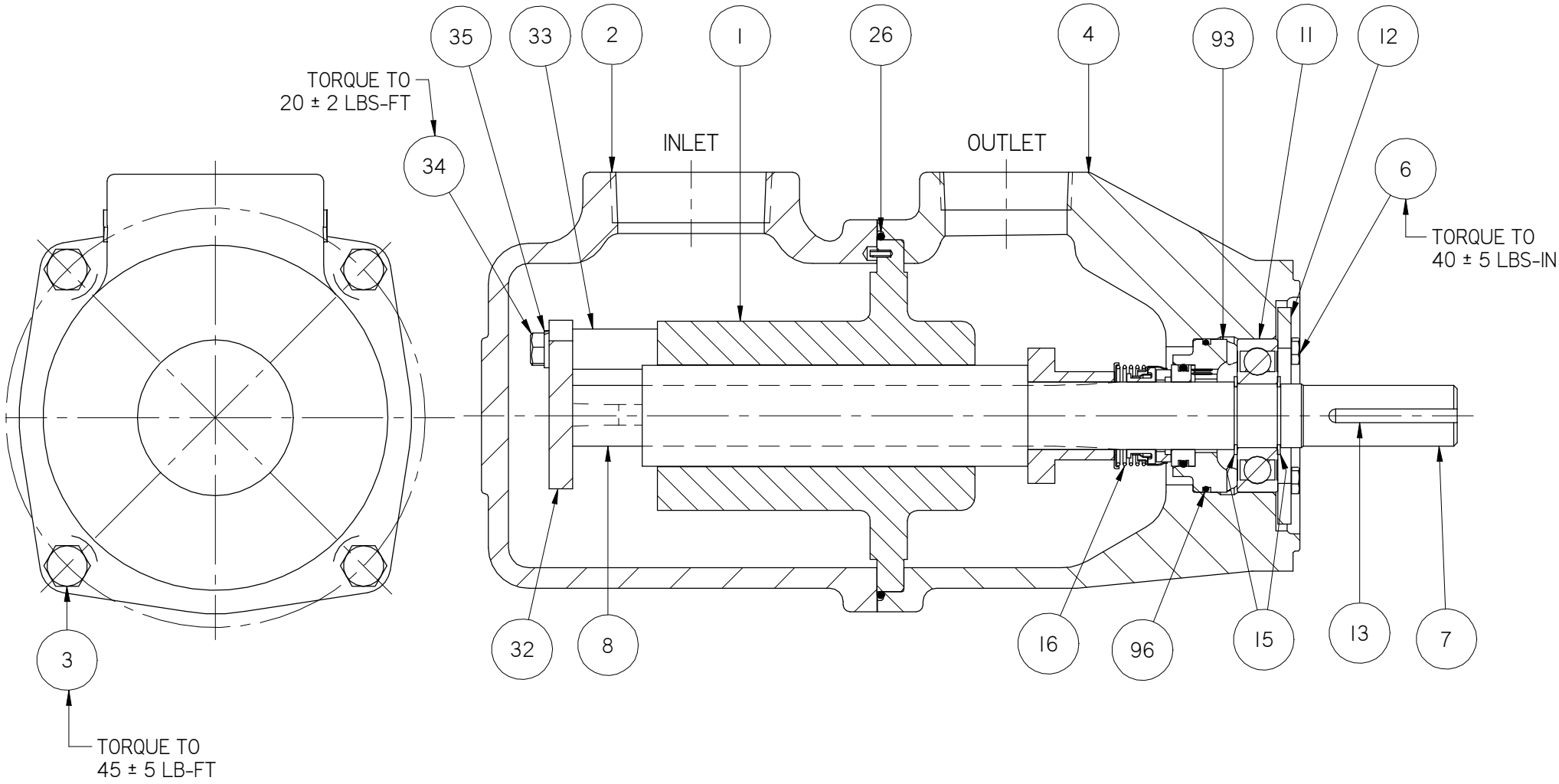


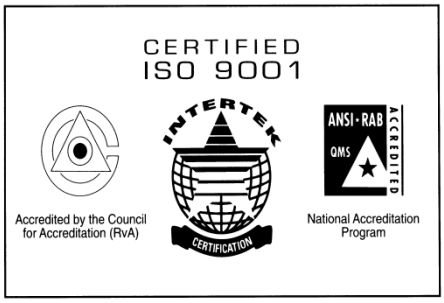

FIGURE 5 - ASSEMBLY FOR FOOT MOUNT & C-FACE (3EN, 3EJ) PUMPS




NOTES:

1. STEEL CASE PUMPS TO USE SAE 4-BOLT FITTINGS.
   IRON CASE PUMPS WILL BE PIPE TAP INLET AND OUTLET.

# FIGURE 6. C-FACE ASSEMBLY SD-5571




**Imo Pump**
1710 Airport Road
PO Box 5020
Monroe, NC USA
28111.5020

*Tel*: +1.704.289.6511
*Toll:* +1.877.853.7867
*Email:* *cc*@colfaxcorp.com
*Web:* colfaxcorp.com

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